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Technical Report

on

## TABLES OF THE GENERALIZED STIRLING NUMBERS OF THE FIRST KIND

by

William F. Pickard

March 1, 1963

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# TABLES OF THE GENERALIZED STIRLING NUMBERS OF THE FIRST KIND

by

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ABSTRACT

The generalized Stirling numbers of the first kind are defined, certain of their basic properties discussed, and tables given for the square grid k = 0(1)10 and j = 0(1)10 with l = -10(1)10.

<sup>\*</sup>The work reported in this paper was supported by a grant from the National Science Foundation.

The use of the losenge diagram [1] to construct polynomial approximations, for interpolation, for the step by step integration of differential equations, for the derivation of formulae for numerical differentiation, and for other purposes, requires the evaluation of the factorial polynomials

(1) 
$$(u-\ell)^{[k]} = (u-\ell)(u-\ell-1)\cdots(u-\ell-k+1)$$

where  $\ell$  and k are integers, k being non-negative and  $\ell$  unrestricted Since  $(u-\ell)^{[k]}$  is a polynomial of degree k it can be represented as

$$(u - \ell)^{[k]} = \ell S_0^k u^k + \ell S_1^k u^{k-1} + \cdots + \ell S_k^k$$

$$= \sum_{j=0}^k \ell S_j^k u^{k-j}$$
(2)

where the coefficients  ${}_{i}S_{j}^{k}$  can be called the generalized Stirling numbers of the first kind in analogy with the terminology used for the numbers  ${}_{0}S_{j}^{k}$ . The  ${}_{i}S_{j}^{k}$  are conveniently determined using the recursive relationship

and the obvious identities

(4a) 
$$\int_{0}^{\infty} s_{0}^{k} = 1$$
  $k = 0, 1, 2, \cdots$ 

Equation (3) is readily derived by expanding

(5) 
$$(u-\ell)^{[k+1]} = (u-\ell-k) (u-\ell)^{[k]}$$

and equating the coefficients of the several powers of u.

Only the  $_{l}S_{j}^{k}$  for l=0 have been extensively tabulated [2]; those for  $l\neq 0$  appear to have been largely neglected. In order to facilitate the construction of formulas from the losenge diagram, the IBM 7090 at the Harvard University Computing Center was utilized to calculate the  $_{l}S_{j}^{k}$  over the square grid k=0(1)10, j=0(1)10 with l=-10(1)10. The results of these calculations are presented in Table I; a blank indicates that the number was zero and the word OVERFLOW that the absolute value of the number exceeded 34, 359, 738, 367.

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